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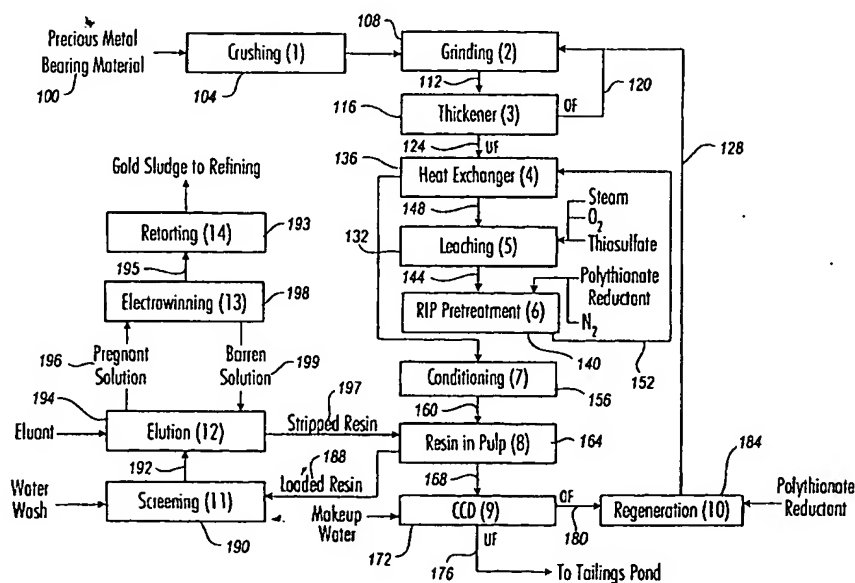
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(54) Title: METHOD FOR THIOSULFATE LEACHING OF PRECIOUS METAL-CONTAINING MATERIALS



(57) **Abstract:** Processes are provided for recovering precious metals from refractory materials using thiosulfate lixivants. The processes can employ lixivants that include at most only small amounts of copper and/or ammonia and operate at a relatively low pH, reduction of polythionates, inert atmospheres to control polythionate production, and electrolytic solutions which provide relatively high rates of precious metal recovery.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/01119

A. CLASSIFICATION OF SUBJECT MATTER		
IPC 7	C22B11/00	C22B3/08 C22B3/00 C22B3/26 C22B3/42
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According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC 7 C22B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
EPO-Internal, WPI Data, PAJ, COMPENDEX		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 316 094 A (BRITISH PETROLEUM CO PLC) 17 May 1989 (1989-05-17)	1,4,7, 14,26, 27,31, 32, 36-41, 44-46, 53,59, 66,72, 76,84 22,30, 42,73,85
A	abstract page 2, line 2 - line 3 page 2, line 18 - line 52 page 3, line 7 - line 19 claims 1,3-5; figure; tables ----- -/--	
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents:		
A document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *Z* document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
21 May 2002		02. 07. 2002
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016		Authorized officer Ceulemans, J

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/01119

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5 785 736 A (FLEMING CHRISTOPHER ET AL) 28 July 1998 (1998-07-28) cited in the application the whole document	54,55 1-7,26, 38,47, 56-59, 73, 77-79,84
X A	US 4 778 519 A (PESIC BATRIC) 18 October 1988 (1988-10-18) column 1, line 12 - line 19 column 3, line 15 - column 4, line 30 column 8, line 1 - line 14 column 10, line 3 - line 52	8-10 12,13
X A	US 5 354 359 A (WAN RONG-YU ET AL) 11 October 1994 (1994-10-11) column 1, line 11 - line 14 column 7, line 45 - column 8, line 4 column 8, line 52 - line 68	8 9,10
X A	US 4 070 182 A (GENIK-SAS-BEREZOWSKY ROMAN M ET AL) 24 January 1978 (1978-01-24) the whole document	67,68 8-13, 22-24,71
X A	AU 18525 99 A (PLACER DOME, INC.) 16 September 1999 (1999-09-16) cited in the application page 13, line 9 - page 14, line 25 claims 1,7,16,19; figures	8 10,22
X A	US 4 369 061 A (KERLEY JR. BERNARD J) 18 January 1983 (1983-01-18) abstract column 2, line 15 - line 31 column 2, line 60 - line 68 column 3, line 48 - line 55 column 5, line 44 - column 6, line 29	15, 17-20, 67,80-83 68-71
X A A	US 5 876 588 A (MENARD HUGUES ET AL) 2 March 1999 (1999-03-02) column 2, line 20 - line 25 column 2, line 44 - column 3, line 4 US 5 536 297 A (FLEMING CHRISTOPHER ET AL) 16 July 1996 (1996-07-16) cited in the application the whole document	60 61,64,65 1-7,26, 38,47, 73,84

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/01119

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 04164 A (NEWMONT GOLD CO ; NEWMONT MINING CORP (US)) 9 February 1995 (1995-02-09) the whole document ---	1-7, 26, 38, 73, 84
A	US 4 654 078 A (PEREZ ARIEL E ET AL) 31 March 1987 (1987-03-31) the whole document ---	67, 95
A	US 4 296 075 A (YAN TSOUNG-YUAN) 20 October 1981 (1981-10-20) the whole document ---	47, 54, 88
P, A	WO 01 23626 A (MALLEY GLEN PETER O ; UNIV MURDOCH (AU)) 5 April 2001 (2001-04-05) claims 1, 2, 8 ---	77-79
E	AU 31355 01 A (BARRICK GOLD CORP) 11 October 2001 (2001-10-11) cited in the application the whole document -----	8-13, 47-52

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 01/01119

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-7,14,26-46,53,59,66,72-76,84-87

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant at superatmospheric pressure.

2. Claims: 8-13

Process for recovering a precious metal from a carbonaceous precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant with (almost) no added copper and ammonia.

3. Claims: 15-21,47-52,54-58,80-83,88-94

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and converting the formed polythionates to thiosulfate.

4. Claims: 22-25

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a lixiviant in 2 steps at different oxygen partial pressure.

5. Claims: 60-65

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a lixiviant and electrowinning the precious metal from the pregnant leach solution.

6. Claims: 67-71

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and inhibiting the formation of polythionates.

7. Claims: 77-79

FURTHER INFORMATION CONTINUED FROM PCT/SA/ 210

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and contacting the pregnant leach solution with an adsorbent.

8. Claims: 95-96

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and inhibiting reaction between thiosulfate and metal impurity after leaching.

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/IB 01/01119

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0316094	A	17-05-1989	AU 2452388 A BR 8805792 A EP 0316094 A2 JP 1156432 A ZA 8808187 A	11-05-1989 01-08-1989 17-05-1989 20-06-1989 25-07-1990
US 5785736	A	28-07-1998	US 5536297 A CA 2209559 A1 CA 2169140 A1	16-07-1996 16-01-1998 11-08-1996
US 4778519	A	18-10-1988	US 4816235 A	28-03-1989
US 5354359	A	11-10-1994	AU 685755 B2 AU 4925793 A BR 9307876 A CA 2167571 A1 CN 1098142 A ,B EP 0712445 A1 MX 9305978 A1 RU 2125107 C1 WO 9504164 A1 ZA 9307288 A ZW 13193 A1	29-01-1998 28-02-1995 06-08-1996 09-02-1995 01-02-1995 22-05-1996 31-01-1995 20-01-1999 09-02-1995 25-04-1994 25-05-1994
US 4070182	A	24-01-1978	CA 1073681 A1 AU 499658 B2 AU 2246177 A ZA 7700840 A	18-03-1980 26-04-1979 24-08-1978 28-12-1977
AU 1852599	A	16-09-1999	US 6251163 B1 ZA 9901710 A	26-06-2001 04-12-2000
US 4369061	A	18-01-1983	US 4269622 A CA 1148748 A1 ZA 8007196 A	26-05-1981 28-06-1983 26-08-1981
US 5876588	A	02-03-1999	CA 2193305 A1	18-06-1998
US 5536297	A	16-07-1996	CA 2169140 A1 US 5785736 A	11-08-1996 28-07-1998
WO 9504164	A	09-02-1995	US 5354359 A AU 685755 B2 AU 4925793 A BR 9307876 A CA 2167571 A1 CN 1098142 A ,B EP 0712445 A1 MX 9305978 A1 RU 2125107 C1 WO 9504164 A1 ZA 9307288 A ZW 13193 A1	11-10-1994 29-01-1998 28-02-1995 06-08-1996 09-02-1995 01-02-1995 22-05-1996 31-01-1995 20-01-1999 09-02-1995 25-04-1994 25-05-1994
US 4654078	A	31-03-1987	NONE	
US 4296075	A	20-10-1981	AU 523931 B2 AU 5017779 A	19-08-1982 29-05-1980

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/IB 01/01119

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4296075 A		CA 1137320 A1 ZA 7905253 A	14-12-1982 27-05-1981
WO 0123626 A	05-04-2001	WO 0123626 A1 AU 7889500 A	05-04-2001 30-04-2001
AU 3135501 A	11-10-2001	US 6344068 B1	05-02-2002